

Few-shot Learning on Human Activity Recognition

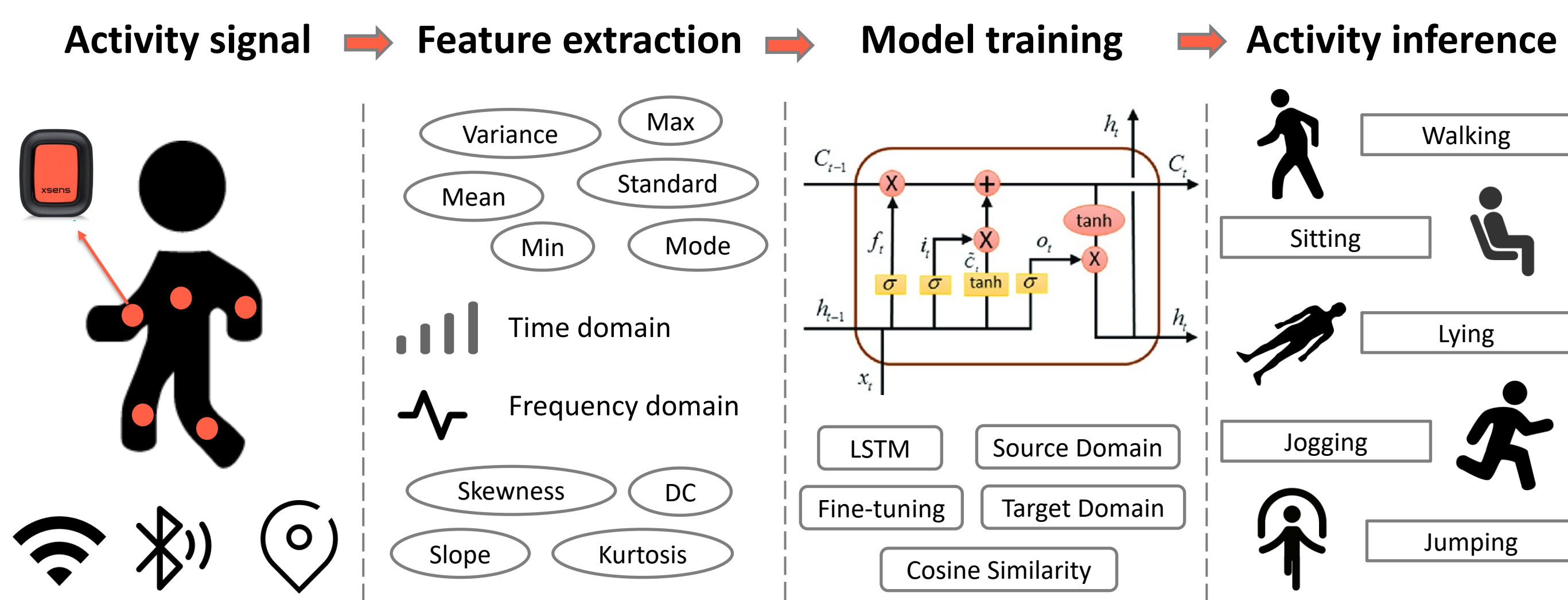
Siqi Chen Xizi Qiao Zehua Xu

TBSI, Tsinghua University, China

Abstract

- Develop a deep learning model to classify human activity properly even with few samples.
- Extract and analyze the activity features based on a multi-body sensor dataset.
- Apply a parameter transfer-based few-shot learning method with stacked LSTM model and two different cross-domain class-wise relevance measures for human activity recognition(HAR).

Introduction



Drawbacks of traditional human activity recognition model

- Need a large amount of data.
- Data for uncommon activities are hard to get.

Application scenario for few-shot learning

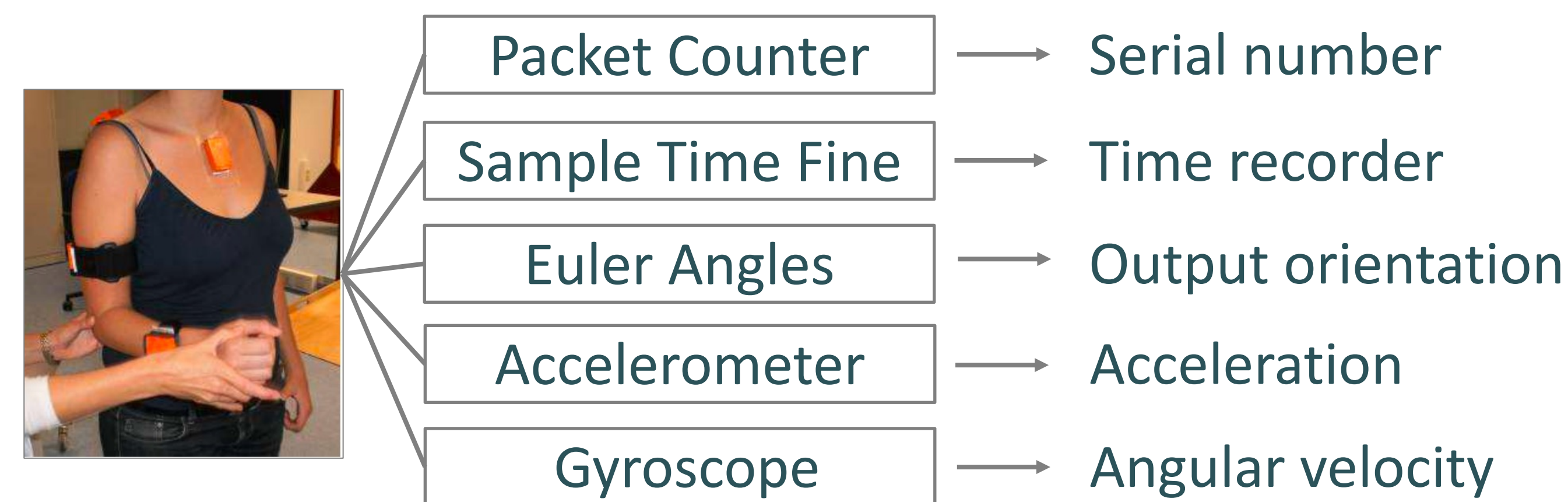
- Multiple data is available for certain activities.
- Very few data is available for some other activities.

Reference

- [1] Snell, J., Swersky, K., & Zemel, R. (2017). Prototypical Networks for Few-Shot Learning. In Advances in Neural Information Processing Systems (NIPS) (pp. 4077–4087).
- [2] L. Wijayasingha and J. A. Stankovic, "Generalized Few-Shot Learning For Wearable Sensor-based Human Activity Recognition," 2022, IEEE, pp. 328-334.

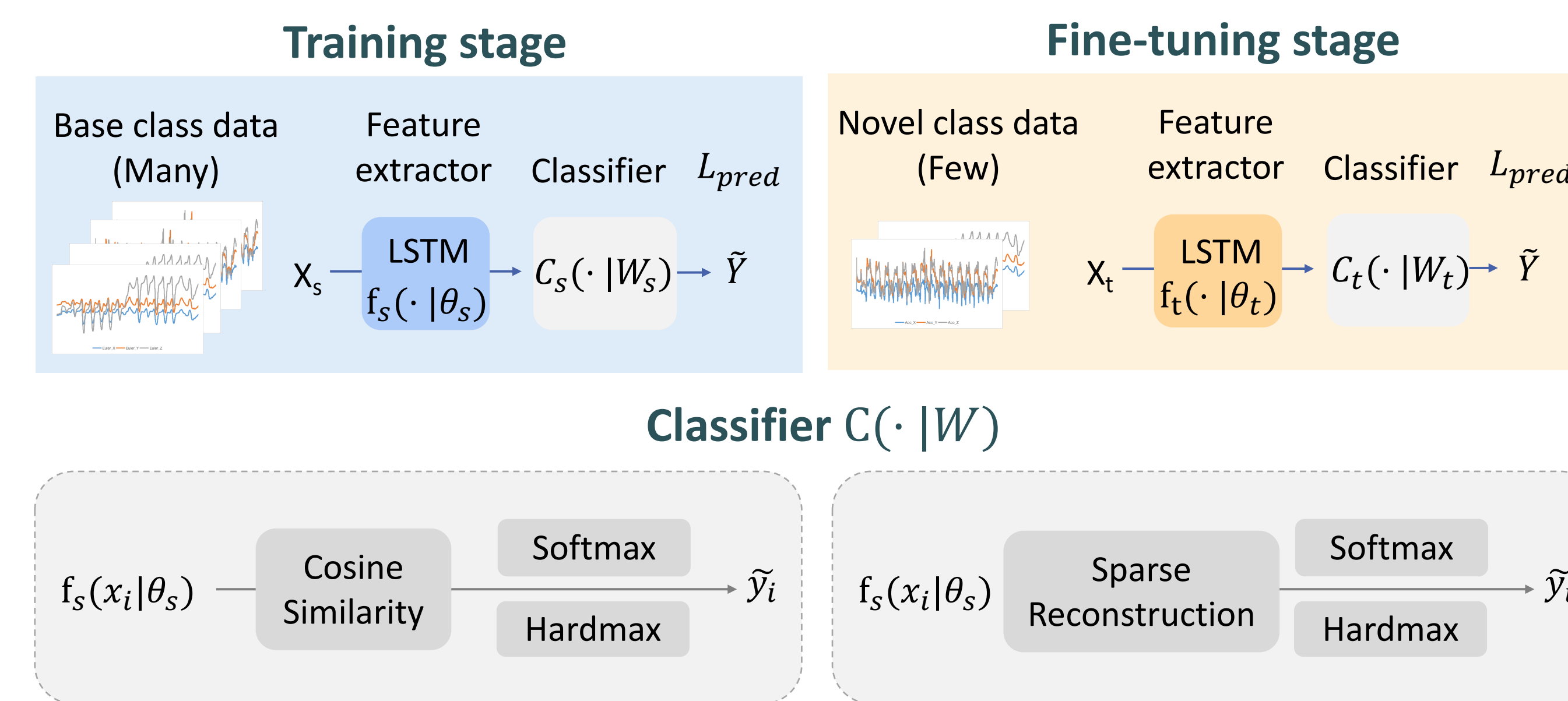
Methods

Dataset



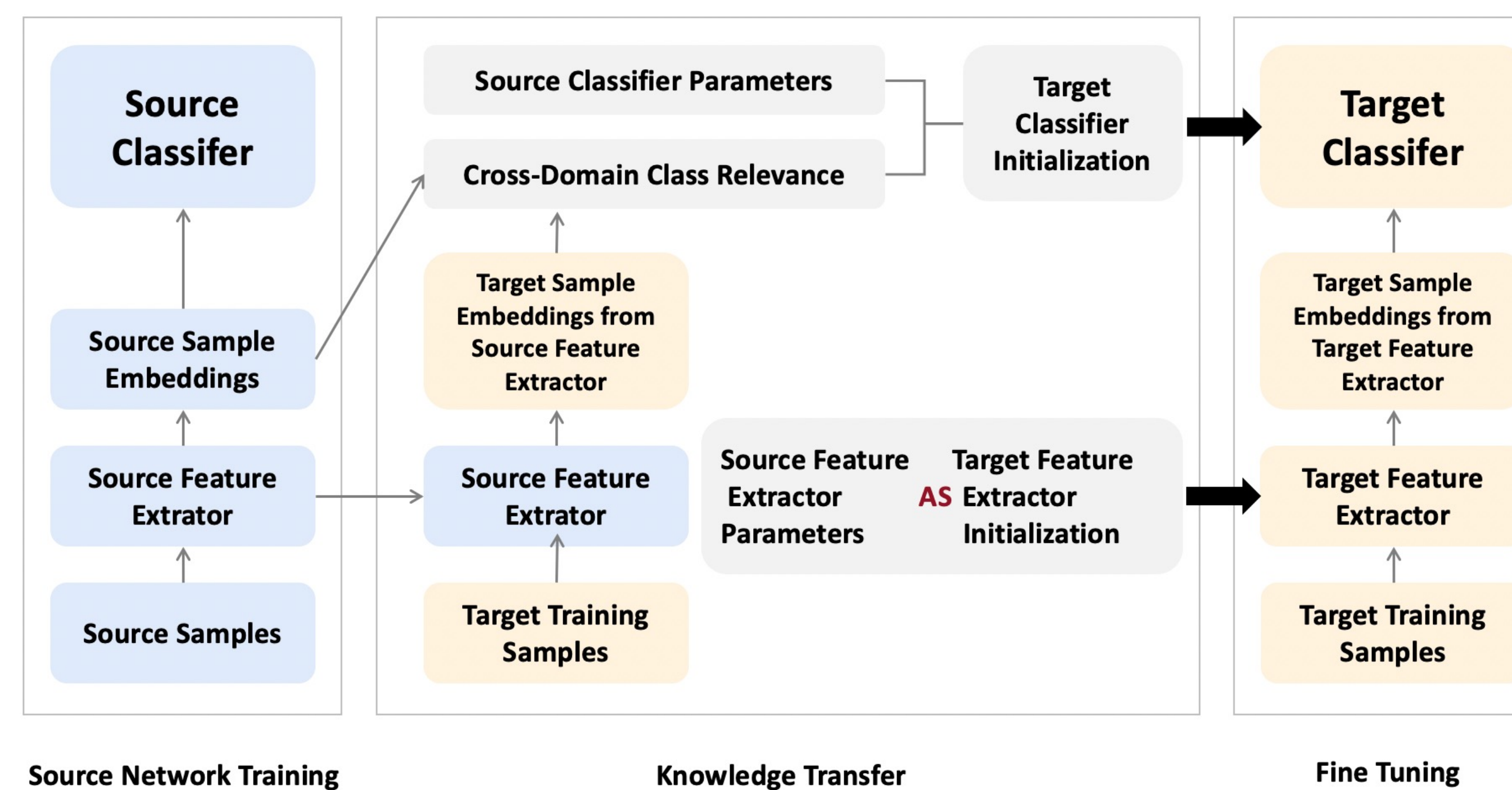
- **Multi-body sensor dataset** : 9 activities captured by 5 IMU sensors attached on human body.

Model structure

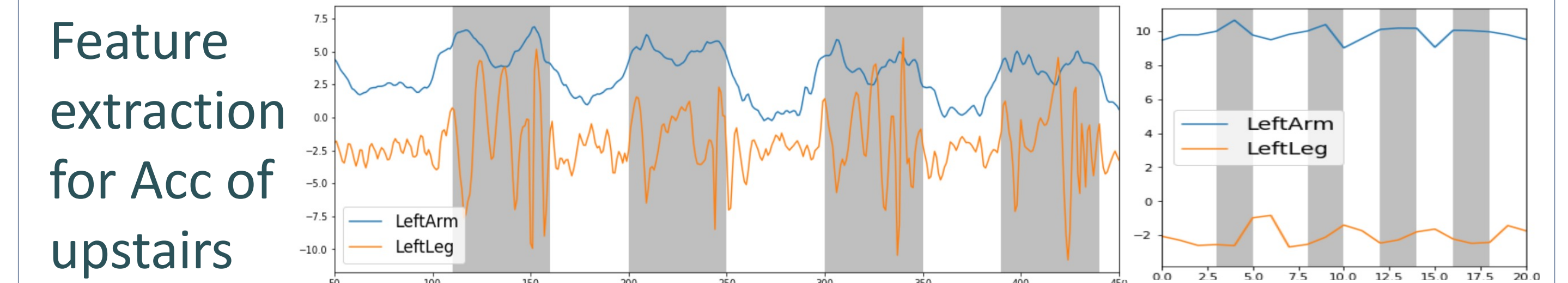


Few-shot learning based human activity recognition model

- Use LSTM to extract features and classify activities.
- Use source data to train the model, transfer its parameter to the target side and make some fine-tuning.

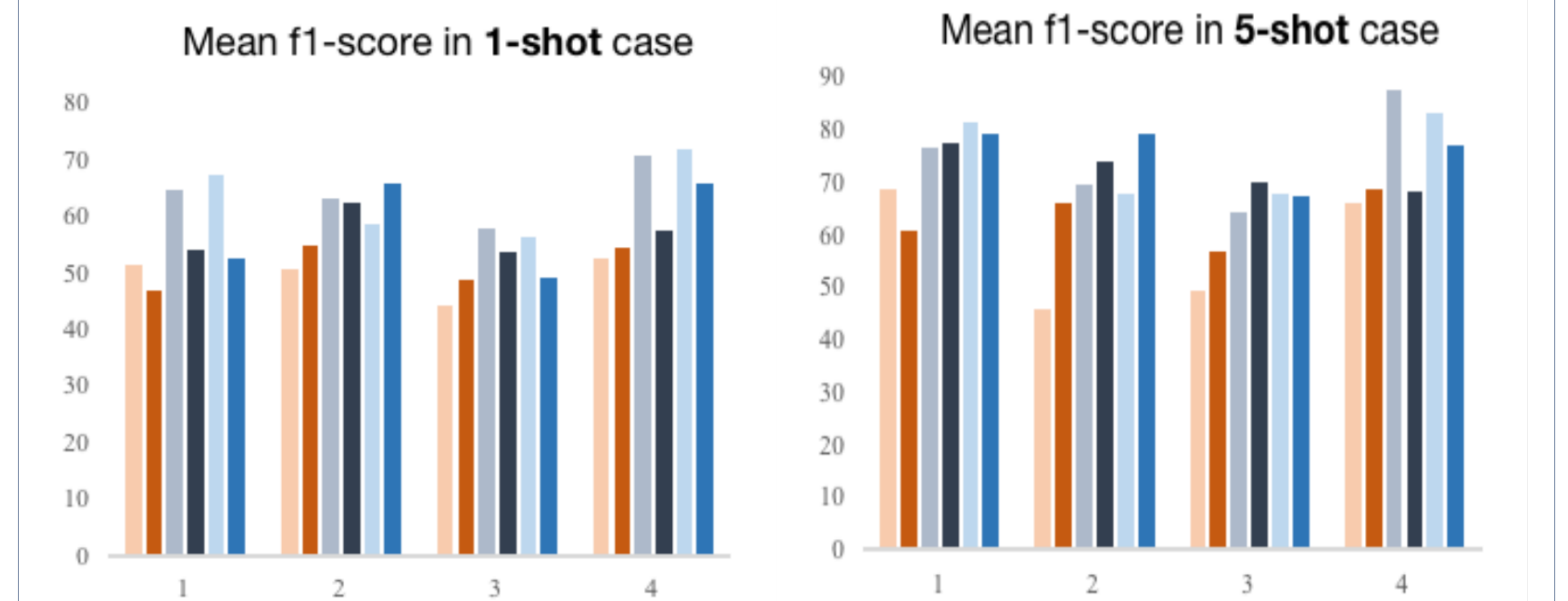


Results

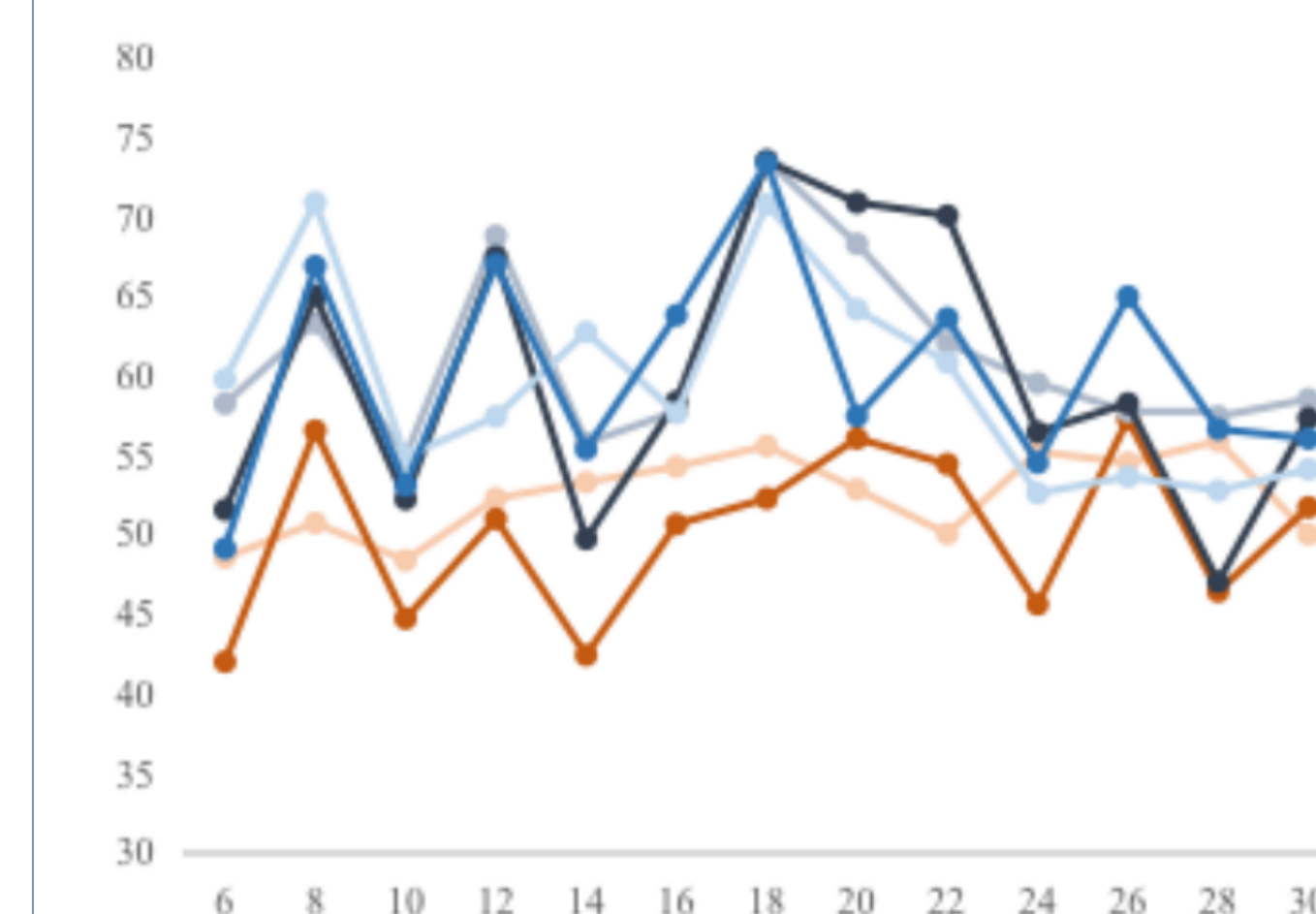


- The motion has obvious periodicity and phase interval.
- Help to divide source domain and target domain properly.

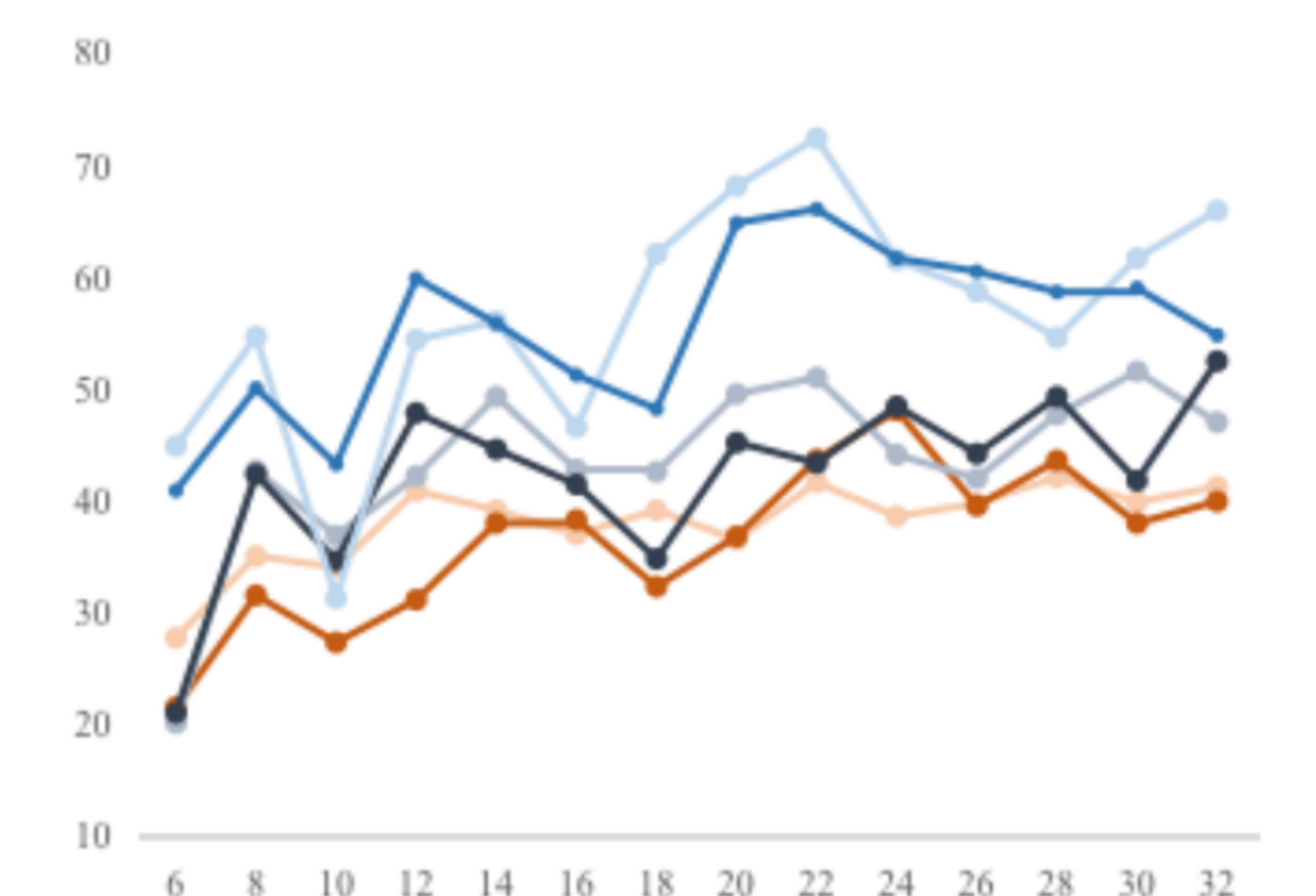
Legend: RandInit (orange), FeTr+Softmax (red), FSHAR-Cos Soft (light blue), FSHAR-Cos Hard (dark blue), FSHAR-SR Soft (lightest blue), FSHAR-SR Hard (darkest blue)



The Impacts of Time Window Length in 1-shot Case



The Impacts of the Complexity of LSTM Network in 1-shot Case



- FSHAR methods perform better than random initialization and feature extractor transfer.
- If the time window length is 18 and the size of hidden layer in LSTM network is 22, FSHAR-SR Soft performs the best.

Conclusion

- Satisfactory HAR results can be achieved even very few training samples are available for each class.
- Transfer learning based methods can perform very excellent when choosing appropriate time window length and the size of hidden layer in LSTM network.